Dr. Peter Shanahan
Neutrino Division/Neutrino Physics Department
Fermilab
NOvA Co-Spokesperson

Prof. Mark Messier
Department of Physics
Indiana University
NOvA Co-Spokesperson

Dr . Nigel Lockyer, Director
Fermilab
Batavia, IL 60510

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Dear Nigel,

We understand from the MINERvA spokespersons that there are discussions underway that impact the proposed future cross-section measurement program in the NuMI beam, and that our recent experience with first measurements of neutrino oscillations using the NOvA detectors might provide some useful background information on the relationship between measurements of neutrino cross-sections and extraction of fundamental neutrino properties.

As you may recall, the initial data seen in the NOvA near detectors showed a large (14%) discrepancy in the hadronic component of neutrino charged-current interactions. This difference was not wholly unexpected as NOvA operates in a transitional energy region (1 - 3 GeV) where several interaction processes (quasi-elastic, resonant, deep inelastic) contribute in nearly equal amounts. Uncertainties in the hadronic system resulted in a 7% uncertainty in our initial measurements of neutrino energy. This uncertainty would have been a limiting factor in the measurements of $\sin^2 2\theta_{23}$ and Δm^2_{23} using muon-neutrino disappearance had they gone uncorrected. Likewise, uncertainties in the modeling of the hadronic components of electron-neutrino events caused us to assign a 14% uncertainty to the efficiency with which we find electron-neutrino charged-current candidates at the far detector which directly impacts our ability to map the electron-neutrino appearance rates to the oscillation parameters $\sin^2\theta_{23,}$ $\sin^2\theta_{13}$, δ_{CP} and neutrino mass hierarchy.

Over the past year, NOvA has worked to understand this discrepancy, homing in on the understanding of neutrino cross-sections as one of the most likely causes. Crucial to these investigations were, of course, our own high statistics near detector data, but we also relied on external measurements of quasi-elastic scattering, resonant production, and deep inelastic scattering by the MINERvA collaboration. Having those data available, and an engaged community of physicists who understood those data, enabled us to converge on a solution to the hadronic energy differences much faster that we would have otherwise. Knowing that our own data shows trends consistent with the MINERvA measurements gives us confidence in our solution.

At the Neutrino conference in July we expect to show updated results where the uncertainties in hadronic energy, neutrino energy, and electron neutrino selection efficiency uncertainties have been reduced to 5% (from 14%), 5% (from 7%), and ~2% (from 14%) which, when combined with improved reconstruction techniques, will improve the physics reach of our results by much more than what would have been projected with the increased statistics only.

Sincerely,

Peter Shanahan and Mark Messier
NOvA Co-spokespersons